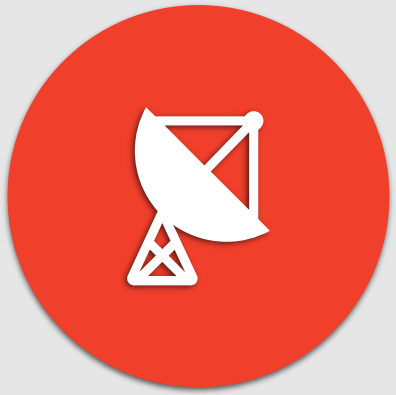
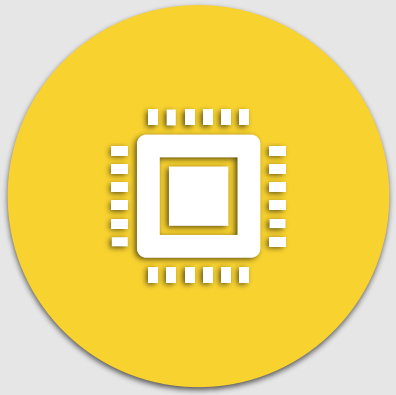
Project Portfolio – Nicholas Tang



MECHANICAL ANTENNA TRACKER DESIGN

UNMANNED AIRCRAFT ASSEMBLY



REFLOW OVEN CONTROLLER

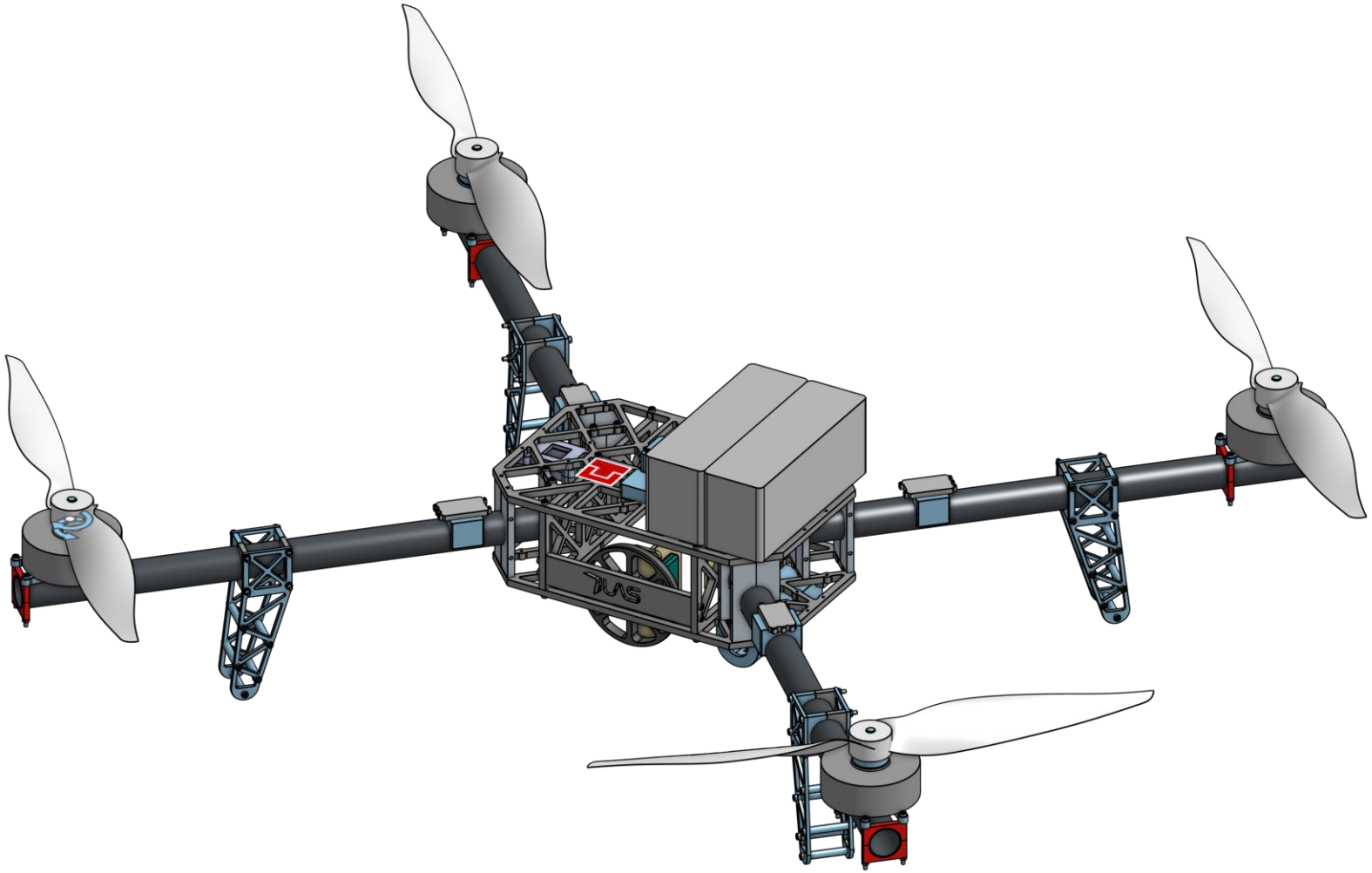
Mechanical Antenna Tracker Design

As a past member of the Radio Communications sub-team on UBC Unmanned Aircraft Systems (UBC UAS), we were in charge of designing a completely new tracker as all models from previous years were unsuccessful. Along with 3 other students, we were tasked with creating the mechanical components of the tracker.

This concept features a ball bearing coupled with a VEX gear below the main plate to allow rotation by a Dynamical motor in the yaw direction, and a mounting board for all the necessary electronics above. The extendable base stand attached allows for greater base height; the two rod plates hold the Yagi-Uda antenna rigid while facilitating pitch rotation. Compared to the designs from the past, this tracker proved successful in both the national and international competitions in 2019.

We modelled the component in SolidWorks and tested its durability under load with ANSYS. A WDM was used to select the best idea from our brainstorm, and parts were either 3D printed or waterjet in-house, with the ball bearing being the exception. Design reviews were conducted throughout the term to garner feedback and adjustments were made accordingly.

I had lots of fun learning about CAD-ing, simulating the device, and creating the device from beginning all the way to the end result.



Aircraft Assembly

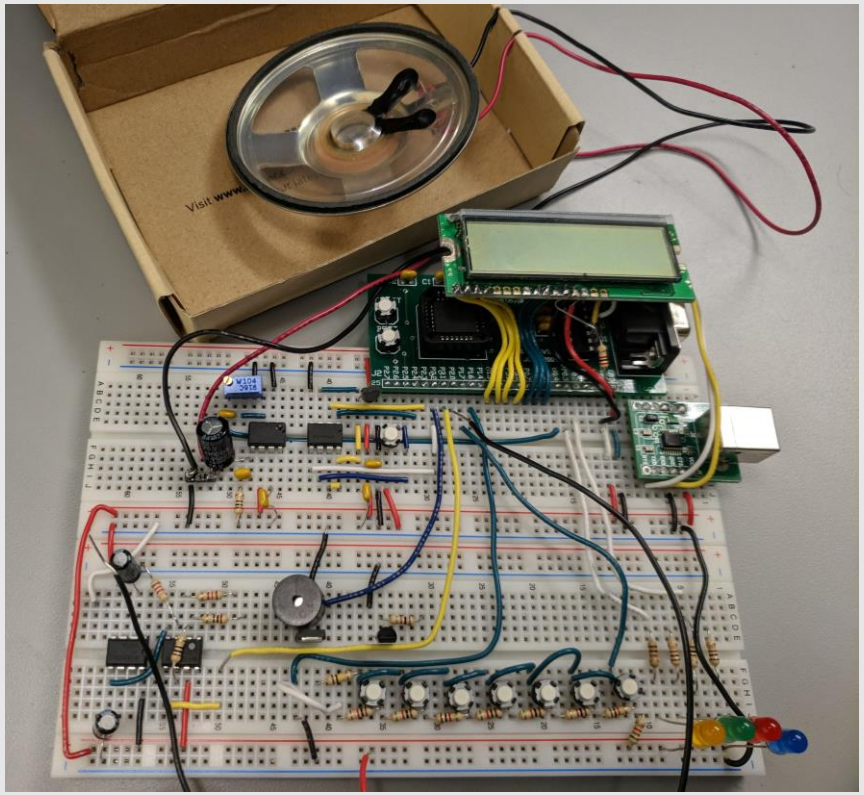
Part of the new competition requirements for UBC UAS this year necessitated the creation of a new drone for greater flight time and distance overall. The current design features a new middle space to keep the rover, shorter landing gears to increase stability, and new electronics to meet the specifications.

I ran simulations with different parts to test maximum flight duration using eCalc and chose the best configuration overall for our drone. Selecting from a variety of parts, we ended with 32Ah 12-cell batteries in total, and motors with Kv of 120rpm/V with 2200W of max power. This allowed for a flight range of 8 miles and a duration of more than 15 mins factoring in a crude estimate of drag, which represents a two-mile increase from last year.

I was also in charge of making incremental improvements to the boom clamps on the edges of the frame and assisted with the assembly of the drone.

This project was thoroughly enjoyable as I gained a deeper understanding of each drone component. I was able to develop my skills in selecting electronic components, soldering, and documenting each decision we make in detail for future reference.

Reflow Oven Controller



One of the main projects from our undergraduate coursework was to use a microcontroller and other corresponding microelectronics capable of controlling an oven to reflow solder PCB components. I was in charge of writing the assembly code for an 8051 microcontroller we used to control the SSR box connected to the oven.

The code contained two timers: one for an alarm going off if the oven malfunctioned; the other a second counter for each reflow step. It had custom parameters to be set such as soak and reflow temperature and time, all displayed on an LCD screen for user-friendliness. The LCD then displayed the live temperature from a thermocouple wire, the timer for the state, and the state of the oven. Finally, a speaker was added to announce the progress of the oven every 5 seconds.

This project was particularly exciting as I had the opportunity to demonstrate elements from my previous laboratory experience to the entirely novel concept of PCB soldering. It was fun to solder together the microcontroller initially, design a breadboard circuit which contained all the buttons, speakers, ICs, and utilizing many features available on the microcontroller to implement our solution.